

# The postnatal development of the white-toothed Shrew *Crocidura russula monacha* in captivity

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## Introduction

Relatively little information is available on the growth and development of the neonatus for most of the families in the order Insectivora, including the Soricidae. There are scattered references to the development of the newborn by GOULD and EISENBERG (1966) for some Tenrecidae, HERTER (1957) for Erinaceidae, and BROWN (1964) for Macroscelididae. For the family Soricidae there are observations on postnatal development in *Sorex araneus*, *S. minutus* and *Neomys fodiens* (CROWCROFT 1957), in *Crocidura leucodon* (FRANK 1954; HERTER 1957), in *C. russula* and in *C. leucodon* (BUTTLER 1953), in *C. bicolor* (ANSELL 1964), in *C. hirta* (MEESTER 1963) and in *C. russula pulchra* (FONS 1972).

The most comprehensive accounts concerning the development after birth in laboratory conditions on captive-born insectivores are those of MARTIN (1968) for *Tupaia belangeri*, CONAWAY (1958) for *Cryptotis parva*, DRYDEN (1968) for *Suncus murinus*, HANZAK (1966) and VLASAK (1972) for *Crocidura suaveolens*, and VOGEL (1970) for *Suncus etruscus*.

There is no previous record on growth and development of *Crocidura russula monacha*, a shrew widely distributed in Israel (HARRISON 1964). This shrew adapts well to captivity and reproduces successfully. Therefore, observations on growth and development in *Crocidura russula monacha* can add basic information for comparative studies of postnatal growth and development in mammals. Certain data on daily development of known-age shrews may also be used as a standard indicator for estimating the age of young shrews caught in the field.

## Materials and methods

The shrews used in this study were all born in captivity in the Research Zoo of the Tel-Aviv University. Maintenance of the colony and basic data on reproduction of *C. russula monacha* were described earlier (HELLWING 1970, 1971). Nests were checked daily in the morning for newborn. Young born the previous afternoon and/or night, were aged as day one. Young which were found sometimes a day or more after the last check-up (there was no nest-checking on Saturdays or holidays) were aged approximately by using the body weight and the color of the skin. New-born shrews were handled mostly with delicate forceps. They were removed daily from the maternal nest, weighed on an electric balance, type Mettler (to 0.1 g.), measured with callipers (to 0.1 mm) and usually examined until day 24 (end of the weaning period).

Daily weight gain was studied on a total of 902 weight records, and body growth on 1158 standard linear measurements (body, tail, hind foot and ear length). Before measuring, the shrews were lightly anaesthetized with ether. Measurements and weights were used only from healthy, normal-looking shrews of known age, regardless of the number born in

the litter. The sexes are not described separately since there is no striking sexual dimorphism in the very young shrew. Daily development, such as movement, opening of the eyes and ears, eruption of teeth, etc., was photographed and/or filmed. The analysis of the protein content in the maternal milk was performed using the method of LOWRY et al. (1951). Sound emission of the young was recorded using a taperecorder Akai X—V.

## Results

### A. Characteristics of newborn young

*Body Weight:* Thirty-nine shrews at day one weighed an average of 0.8 g (range 0.5 to 1.1 g) including the milk in the stomach. The initial body weight of *C. russula monacha* at birth is variable and depends apparently on two factors: the quantity of milk present in the stomach (at weighing) and the litter size. Individuals of a low body weight are found in large litters (4—5 young), while those in small litters are heavier: in litters with two young, the mean body weight is c. 1 g in contrast with the mean body weight of 0.78 g in litters with four young, as based on 26 litters.

Generally in *C. russula monacha*, the mean body weight of the newborn represents c. 10% of the body weight of the adult animal (8.5 g).

*Body length:* Body length of newborn *C. russula monacha* ranges from 2.4 to 3.1 mm with an average of 2.7 mm. Mean tail length is 0.86 mm, mean hind foot length is 0.47 mm and mean ear length is 0.30 mm. A striking disproportion between the small body and the huge dimensions of the head and its long rostrum is remarkable in the neonatus.

*Integument:* Immediately or several hours (8—12) after birth, the skin of the newborn is not yet pigmented. It is thin, nearly translucent and appears reddish-pink in color. Twenty-four hours later the reddish color begins to fade to a pale pink, especially on the back. The skin is loose, wrinkled and only a few short colorless guard hairs are dispersed on the tail and the dorsal part of the body. The vibrissae on the snout are long (2—5 mm) and colorless, and only the hair bulbs appear dark red because of the rich blood supply in this part of the body. The thin skin of the belly is hairless and the stomach, distended with milk, is visible as a yellowish-white patch through the bare skin of the abdominal wall (Plate I, photo 1). Some other internal organs, such as the liver and intestines, are also visible. The surface of the dorsal part of the skull, the large superficial blood vessels and the vertebrae of the tail, are visible through the skin. White, well-developed claws are present at birth.

*Fused and closed organs:* The skin between digits II, III, IV and V is fused proximally about half the length of the digits. The lips of the mouth are sealed about two-thirds from each corner, leaving free only a small medial opening large enough to introduce the mother's nipple. The urodeal lips of the cloaca are sealed. The eyes are closed; only a black point (iris) is visible through the skin. The ears are closed and the thick folds of the external ear are closely applied to the lateral parts of the head (Plate I, photos 2, 3).

There are three pairs of nipple sites in the newborn female, which are difficult to detect on the first day. The glans penis is not yet visible. The umbilicus is relatively short (Plate I, photo 2) and its dark-green color contrasts with the pink color of the ventrum.

*Behaviour and activity:* On the first day suckling is relatively strong; the young are already able to nurse. A certain muscular co-ordination exists; when overturned the newborn usually rolls its body until it reaches a normal position and when touched it tries to crawl away. Sometimes the newborn are even able to raise

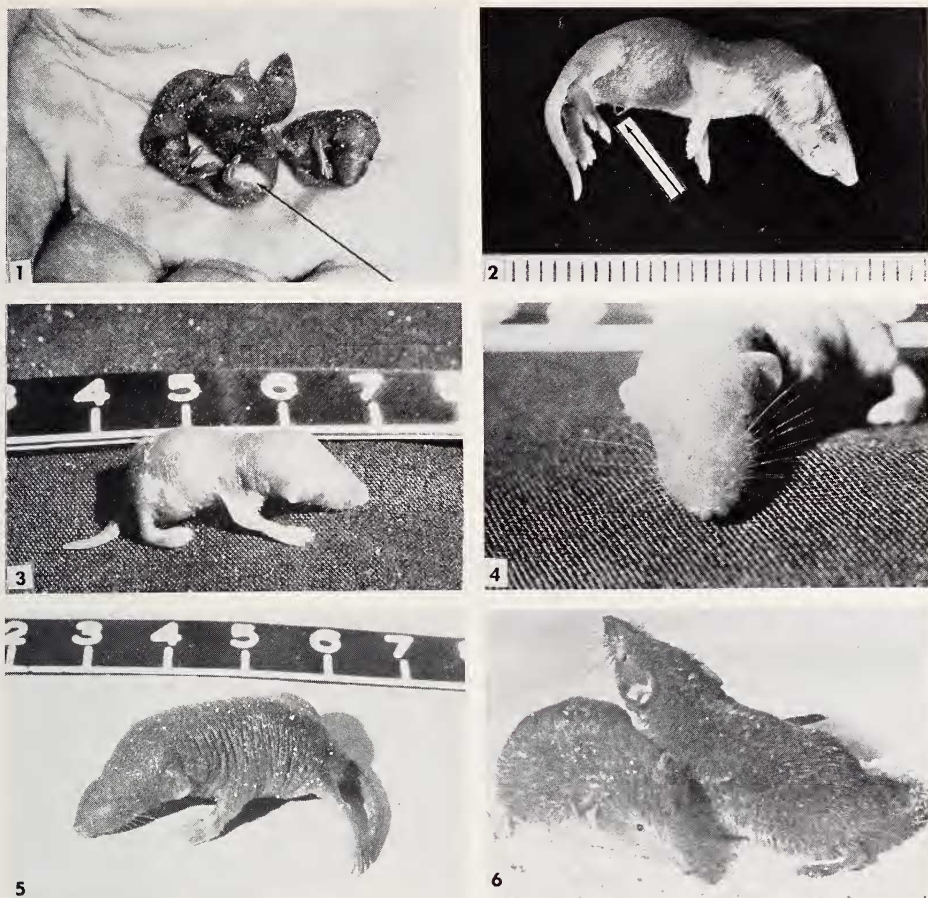


Plate I

Photo 1. The newborn *Crocidura russula monacha*. Note the distended stomach with milk (arrow) — Photo 2. Young *C. russula monacha*, age 1 day. Note the rest of the umbilicus (arrow) — Photos 3 and 4. Young *C. russula monacha* at 2 days of age. Note the loose skin and the long colorless vibrissae — Photo 5. Young *C. russula monacha*, age 4 days. Note the dark-gray pigmentation of the skin and the bicolored hind feet — Photo 6. Two young *C. russula monacha* 3 days after weaning (27 days of age)

the head from the floor for a short period of time. But generally, they lie in the nest making little movement. When the mother leaves the nest, the young emit weak chirping or twittering sounds.

### B. The development during lactational period

*The skin:* During days two and three the skin is less translucent and the onset of dermal pigmentation becomes obvious, as hair pigments begin to concentrate under the skin. A typical medium-gray or dark-blue pigmentation appears on the hind limbs and tail, but it is especially visible on the skin of the dorsum (Plate I, photo 5). The ventral part of the body is still pink. The sites of the lateral scent glands are visible as light colored, oval, hairless spots. The facial vibrissae on the muzzle are longer, but are still colorless. At 4 to 7 days the skin of the dorsum, the middle



part of the muzzle, tail and hind limbs are dark-gray, sometimes nearly as black as graphite, and the first long hairs of the underfur are visible. The belly is still pink, but with a slight tendency to a darker (gray) pigmentation. Some colorless hairs appear on the ventral part of the body.

The limbs, especially the hind feet, appear clearly bi-colored: the outer side of the foot is darker and covered by short (1.2—2.0 mm) gray hairs. By days 8 to 10, short dense hairs are visible and the dorsum becomes furred (dark-gray, nearly black). The skin of the ventral part presents a darker pigmentation, but always remains lighter than the dorsum. The underfur of the belly develops, but is relatively shorter and sparser. The tail, the hind and forefeet are well haired. The facial vibrissae are longer (c. 15 mm) and darker in color, especially at the base.

From days 11 to 15 a short, gray fur completely covers the body: the pelage on the dorsum is soft, velvet-like and dark-gray; the hairs of the ventrum are shorter and usually a lighter gray in color than the dorsum. The gray, bare bases of the nipples in females are in contrast to the fur of the belly. The vibrissae measure c. 15—20 mm and are generally colorless at the tip (Fig. 1).



Fig. 1. A two-week old *Crocidura russula monacha* (original drawing by W. FERGUSON)

From days 15 to 24 the pelage becomes denser and reaches its maximum length. At the end of the weaning period (24 days) juvenile males and females have a uniform, dark-gray coat, slightly lighter on the ventrum (Plate I, photo 6). The bases of the nipples in the females are already covered with the growing fur.

**Eyes:** The eyes open approximately 10 days after birth, but in 25% of the shrews which were observed, eyes began to open slightly earlier. By days 7, 8 and especially 9, a narrow slit in the eyelids is visible, indicating the onset of eye opening. In some shrews, only one eye opens at first, the second one opening the following day, or even later. At the end of the 10th day, the process of eye opening is completed.

**Ears:** From days 5 to 7 the folds of the external ear become gradually free from the head skin and their margins are covered by short, fine, dark-gray hairs. On days 7 to 10 the external ear meatus gradually enlarges and the hairs on the ear notch are longer and darker. From days 10 to 12 onwards, the ear resembles that of an adult animal (Plate II, photos 11, 12).

**Mouth and teeth:** Until day 3 or 4, the mouth remains sealed at each corner. From day 4 the lips begin to separate and the mouth gradually enlarges. On day 5 or 6 the mouth was completely open in almost all shrews under observation. At that time no teeth are visible. The palatine ridges are very prominent. On day 6 or 7 some teeth are already definitely formed, but are visible only through the gums, permitting the determination of teeth position. On days 8 to 9 the upper and lower premolars and the first upper incisors erupt (Plate II, photo 10). On days 11 to 12 the first and second upper molars erupt. Eruption of the lower incisor and the lower molariform teeth takes place a day or two later. By days 13 to 14 most of the teeth have erupted. Among the last teeth to appear are the canines (third unicuspid) and the third upper and lower molars. From the age of 15 days, the entire dentition has erupted through the gums and the process of dentition development is accomplished.



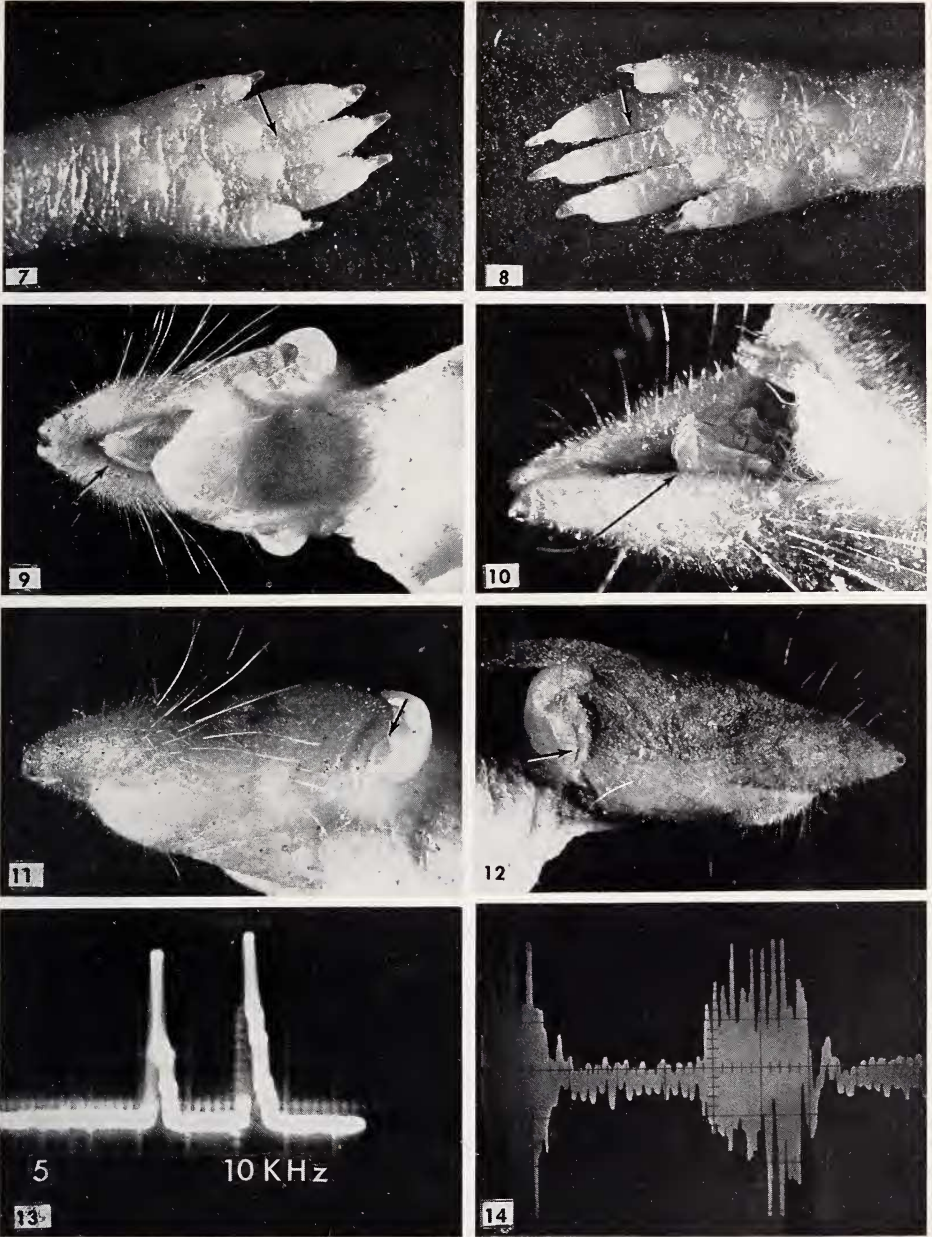


Plate 11

Photo 7. *C. russula monacha* at 4 days of age. The fingers are fused — Photo 8. *C. russula monacha* at 8 days of age. The fingers are free — Photo 9. *C. russula monacha* at 4 days of age. Ventral view of the mouth; note absence of teeth — Photo 10. *C. russula monacha* at 8 days of age. The teeth begin to erupt — Photo 11. *C. russula monacha* at 4 days of age. The ears are entirely closed — Photo 12. *C. russula monacha* at 8 days of age. A slit-like aperture appears in the external ear — Photo 13. Oscillogram of sounds emitted by a young *C. russula monacha* at 2 days of age — Photo 14. Oscillogram of sounds emitted by a young *C. russula monacha* at 4 days of age

*Digits:* The toes begin to separate gradually by day 4 or 5. On day 8 or 9 the digits of the hind feet and fore feet are entirely free (Plate II, photos 7, 8).

*Cloaca:* The labia of the cloaca separate from the third day onwards. On the sixth day the glans penis becomes visible when the perineal region is pressed in an anter-posterior direction.

A summary of some developmental events in *C. russula monacha* are represented in Fig. 2.

*Activity, sounds:* Shortly after birth the shrews move only a little in the nest; after 2 to 3 days they attempt to crawl on their bellies. Long before ears and eyes were open, the young shrews were observed to move quickly in the nest. When resting, they usually lie crowded one upon the other, licking and sniffing each other. By days 7 to 10 the shrews can already walk, jump and climb. From day 10 onwards the young appear to be independent of the nest. They leave it temporarily and walk around, exploring the cage.

From day 14 onwards, activity in the cage is more intense: the young shrews run around the cage, then stop suddenly and try to stand erect for a few seconds on the hind feet, sniffing rapidly with the muzzle and testing the air. They climb on the ceiling of the cage, jump down and feed partially on solid food. The fore feet are used for cleaning the body and grooming. When touched, they become very excited and react by biting. Rarely does fighting between two youngsters occur. Caravan formation was observed from day 6, when eyes and ears were closed and

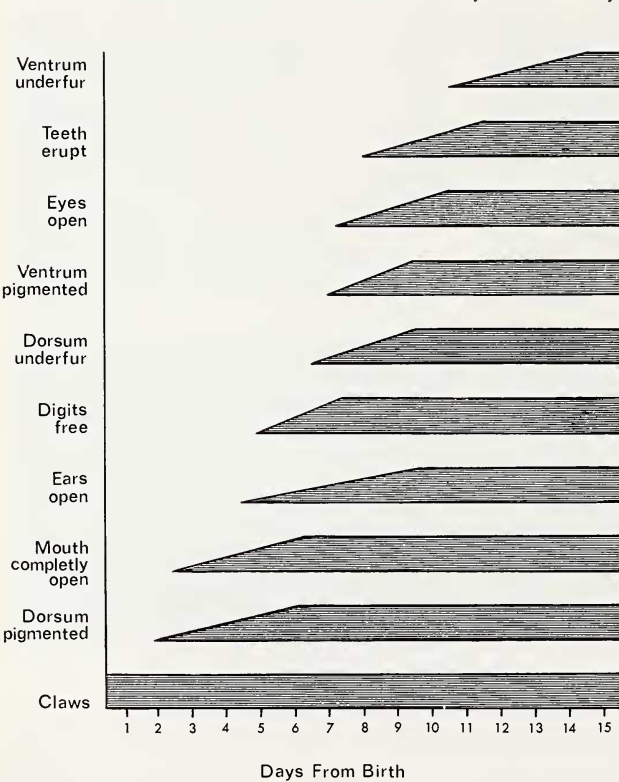


Fig. 2. Developmental events of captive-born *C. russula monacha*. The pointed part of the column represents the day the character appeared; the full column marks the day when the character was observed in all shrews

teeth were visible through the gums. Caravanning was seen until days 20 to 22. Audible and inaudible (ultrasonic) sounds are emitted by the young during the whole lactation period, especially when the mother leaves the nest or when the young are touched or displaced. Plate II, photos 13, 14 show the oscillograms of sounds emitted by young of age 2 and 4 days when they were removed from their mother and touched with forceps. When the young grow older (22 days) sound emission becomes less common.

Suckling generally lasts about 22 to 24 days. On day 13 or 14, however, infant shrews have already started to feed partially on solid food.

*Body weight development:* *C. russula monacha* gain body weight very

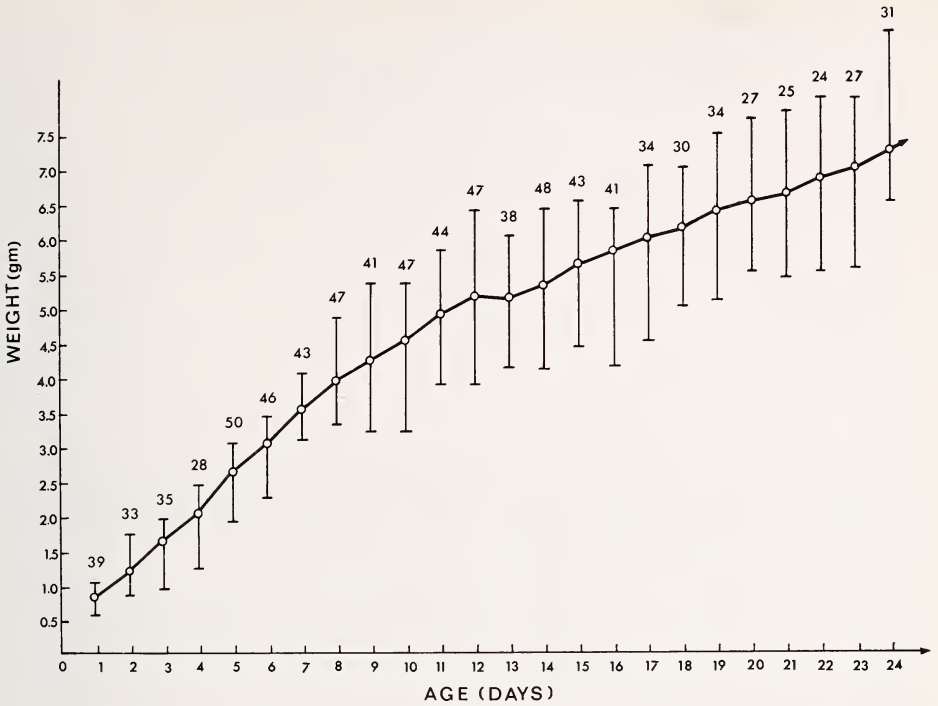


Fig. 3. Weight gain of *C. russula monacha* — during the nest phase (males and females). Open circles represent mean weight and vertical bars range

rapidly during the first days. On the third day the initial mean body weight increased twofold (from 0.8 to 1.63 g). Fig. 3 represents the growth curves of the body weight in *C. russula monacha*. The specific growth rate is presented in Fig. 4. The highest growth rate was recorded in the first 2 to 3 days of life; then the growth curve

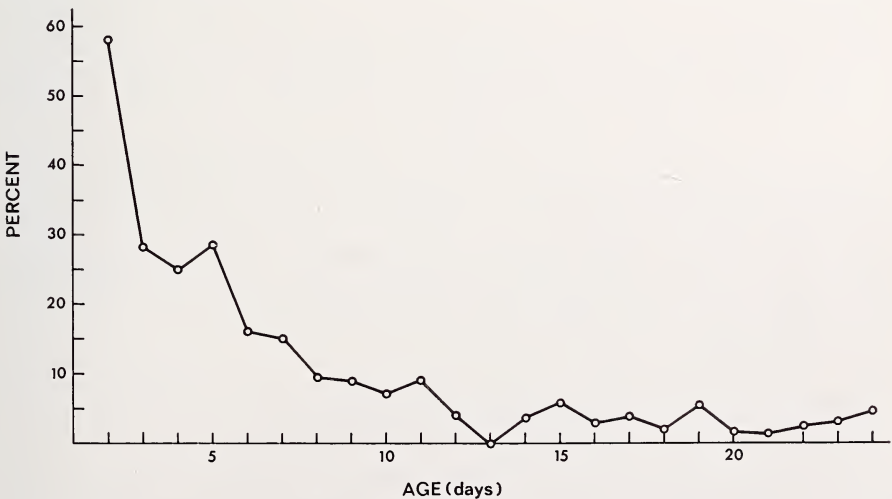


Fig. 4. The specific growth rate (in %) in *C. russula monacha* from birth to weaning



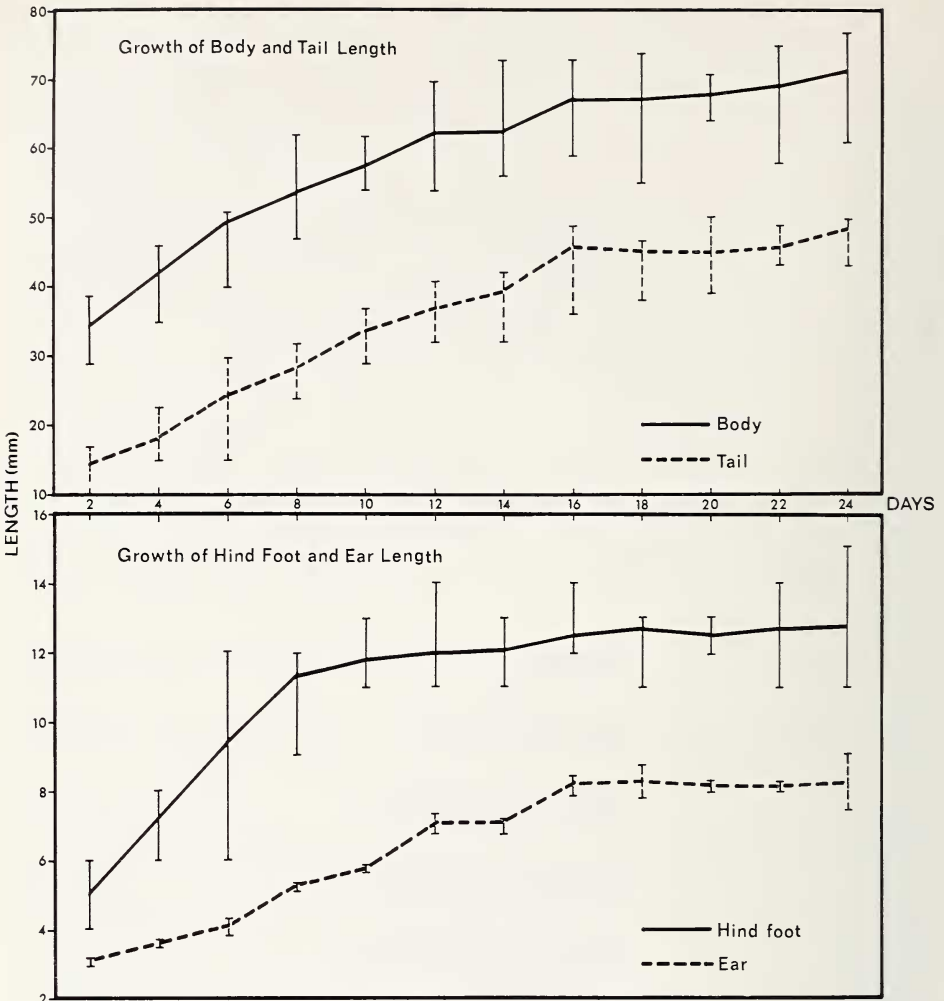


Fig. 5. The growth of the body, tail, hind foot and ear lengths in captive-born *C. russula monacha*. Horizontal line represents mean, vertical bar range

declines to a minimal point on day 13 (when the shrews begin partially to feed on solid food). On this day, the rate of increase is zero. Afterwards, the growth rate of the body weight rises again but never reaches the peak established in the first 3 days of life. Just prior to weaning, the total mass of a mean litter (3) is approximately three times that of the mother's own body weight. At birth the modal litter size (4) represents a total weight of 3.0–3.2 g, which constitutes c. 37.5% of the adult's body weight.

*Body length development:* The body length prior to weaning increases less rapidly than the body weight. While body weight increases ninefold, the body length only increases 2.2 fold (from 2.7 mm at birth to 6.6 mm at weaning). The length of the ear and the length of the hind feet increase 2.6 and 2.5 fold respectively at weaning. The tail is the only part of the body which grows faster. Three days after birth the tail has doubled its initial length. By weaning, the tail length has increased 4.6 fold (see Fig. 5 and Table 1).

Table 1  
The increase of the body weight and body lengths  
in *C. russula monacha* from birth to weaning  
(averages)

body character	N	at birth	at weaning	increase x fold
body weight	902	0.8 g	7.2 g	9.0 fold
body length	311	29.0 mm	66.1 mm	2.2 fold
tail length	292	9.3 mm	43.4 mm	4.6 fold
hind foot length	292	5.0 mm	12.5 mm	2.5 fold
ear length	263	3.1 mm	8.3 mm	2.6 fold

*Protein content of milk:* A rapid body growth indicates a high protein content in the milk suckled by the young (BEN SHAUL 1962; BERNHART 1961). Using a syringe, shrew milk was extracted from the stomach of young shrews immediately after suckling and found to contain 10% protein. This relatively high protein content in the milk of *C. russula monacha* (cow milk has a protein content of 4%) can partially explain the rapid growth of the nestlings in our shrew colony.

*Development of the gonads and accessory glands:* The male — In the first days of life the testes are minute, white or yellowish-white in color. The seminiferous tubules are not visible through the tunica albuginea. The diameter ranges from 72–130  $\mu$  ( $M = 90 \mu$ ). The accessory glands are minute, almost transparent. At 8 to 10 days a characteristic pigmentation correlated with the process of steroidogenesis appears in the testes; they are light green in color and the seminiferous tubules become gradually visible through the tunica. At 10 days the diameter of the tubules varies from 130–160  $\mu$  ( $M = 135 \mu$ ). At 30 days the diameter already ranges between 170–240  $\mu$  ( $M = 200 \mu$ ). In adult males the seminiferous tubules measure only 200–260  $\mu$  ( $M = 235 \mu$ ), i. e. at the age of 1 to 1½ months, the seminiferous tubules apparently stop growing (see Fig. 6) and this period coincides with the age of sexual maturation.

The female — In the newborn female the ovary is minute, flat and solid, filled with germ cells and stroma. The mean diameter of the largest follicle is about 46.0  $\mu$ . At 18 to 20 days follicle development has progressed; besides small and medium-sized follicles, larger follicles with diameters ranging from 198–298  $\mu$  ( $M = 265.8 \mu$ ) appear in the ovary. No larger follicle diameters are found in the adult female prior to copulation.

*Development after weaning:* At weaning (24 days) the males are heavier than the females. The mean body weight of the male is 7.3 g, in contrast to 6.8 g in the female (see Fig. 7). This indicates a clear sexual dimorphism as expressed in body weight. After weaning the male and female continue to gain weight, but this increase is very small. Shrews attain nearly adult proportions a short time after weaning. Only the juvenile fur, a uniform dark-gray coat, distinguishes them from the adult animal.

## Conclusions and Discussion

*Crocidura russula monacha* is a typical nidicolous mammal: it is born entirely naked with sealed eyes and closed ears. The altricial state of development of the neonatus is rapidly compensated by an extremely rapid growth after birth. This rapid body

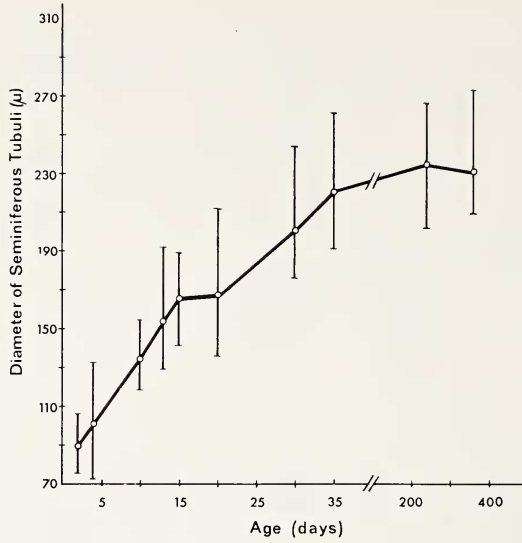


Fig. 6. The growth of the seminiferous tubules in the male *C. russula monacha* born in captivity. (Open circles represent mean, vertical bar range).

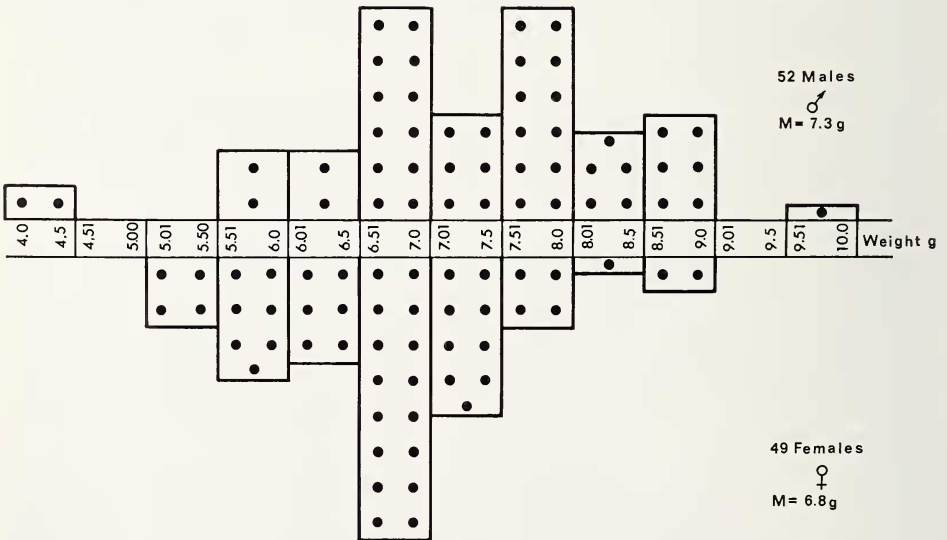


Fig. 7. The body weight in *C. russula monacha* (females and males) on day 24 of age (end of weaning).



growth in the nest is apparently correlated to the high protein content (10%) in the milk.

The development of *C. russula monacha* in captivity can be divided into three stages:

1. the nest phase (1–22 days)
2. the stabilization phase after weaning (22–45 days)
3. attainment of sexual maturity (from 45 days onwards).

During the nest phase general growth processes take place; eyes and ears open, teeth erupt, hair appears, the young suckle, perform caravanning, and emit characteristic sounds. At the middle of the lactation period, the young begin to feed partially on solid food.

During the stabilization phase shrews stop suckling and caravanning. Their emergence from the nest takes place, body growth is slowed up, and the main activity is climbing and burrowing; sexual behaviour is entirely absent.

By the age of 1½ to 2 months, sexual maturity is attained. At this age mature spermatozoa are found in the testis and epididymis. Large, healthy follicles are present in each ovary. Patterns of sexual behaviour develop gradually and mating activity begins. The first litters are delivered.

The time required for *C. russula monacha* to double the birth weight ( $T_2$ ) is three days and sets a record for small nidicolous mammals, since generally in primitive nidicolous mammals this time is about 5 to 10 days (MARTIN 1968).

The most rapid weight gain in *C. russula monacha* can be observed from birth until day 12. Such rapid weight gain is characteristic of some other shrews, such as *Cryptotis parva* (CONAWAY 1958). In this species the maximum growth rate occurs between days 6 to 10. In *Suncus murinus* (DRYDEN 1968) the most rapid relative weight gain occurs also before day 10, for both males and females. In *Crociodura suaveolens* (HANZAK 1966) rapid weight gain occurs until day 11, or on day 10 (VLASAK 1972). Only in *Suncus etruscus* (VOGEL 1970) is body weight gain obviously delayed, reaching its peak on day 19. From this day onwards, there is a slight tendency towards a decrease in the body weight.

The marked drop in body weight increase on day 13, observed in *C. russula monacha*, was also found in *C. suaveolens* on about the 10th day of age until about the 15th day (VLASAK 1972). While individuals of *S. murinus* continue to gain weight until approximately two months of age, *Crociodura russula monacha* appear to reach adult body weight after the first month of life and resemble from this point of view *Cryptotis parva* (CONAWAY 1958).

The ages at which eyes open, teeth erupt, fur appears, are more or less similar to the ages established for other shrews of the subfamily Crocidurinae (see Table 2.) The only exception is *Suncus etruscus*. In this shrew the eyes open relatively late (14 to 16 days) and teeth erupt even later (15 to 19 days). Therefore, it appears that the major changes in *Suncus etruscus*, during neonatal development, present a clear delay (heterochronism) when compared with other Crocidurinae so far studied and in which the gestation period is more or less similar: 27½ to 28 days.

In *C. russula monacha*, *C. suaveolens* and *Suncus murinus* the eyes open very early (9 to 10 days of age). The age at which eyes open in most of the white-toothed shrews – Crocidurinae – coincides with the age at which the eyes of several Tenrecidae open (GOULD and EISENBERG 1966; DRYDEN 1968) (see Table 3).

In the subfamily Soricinae postnatal development is generally much slower when compared with the Crocidurinae, and this is apparently related to the most altricial (primitive) state of embryonic development known so far in the Eutheria (VOGEL 1970). In *Sorex araneus*, for instance, the eyes open late, only in the third week of life, and self-supporting life (independent feeding) begins on day 22.

Table 2  
Comparable data on postnatal development in some Crocidurinae

character	<i>Crocidura russula monacha</i> HELLWING	<i>Crocidura suaveolens</i> (HANZAK 1966) <sup>1</sup>	<i>Crocidura leucodon</i> (FRANK 1954)	<i>Crocidura bicolor</i> (ANSELL 1964)	<i>Suncus murinus</i> (DRYDEN 1968)	<i>Suncus etruscus</i> (VOGEL 1970)
dorsal fur	10—11 days	9 days	10 days	6—7 days	8 days	8 days
eyes open	7—10 days	10 days	12—14 days	10 days	7—10 days	14—16 days
ears open	8—10 days	9 days	—	8 days	5—9 days	10 days
teeth erupt	8—15 days	—	—	11 days	♂ 10.7 days ♀ 8.7 days	15—19 days
caravanning independent feeding	6—22 days 13 days	8—20 days 15 days	8—18 days 18 days	7 days 14 days	begins on day 9 19—20 days	10—16 days 20—21 days

<sup>1</sup> Names in parenthesis refer to authors from literature.

Caravan formation, a behaviour characteristic of the Crocidurinae only, begins to develop in *C. russula monacha* at the age of 6 or 7 days, as in *C. bicolor* in Africa (ANSELL 1964), or *C. suaveolens* in Europe (VLASAK 1972). It appears latest in *S. etruscus* — 10 to 16 days (VOGEL 1970). Caravanning begins before eyes open and this particular behaviour seems to be dependent on hearing (DRYDEN 1968), as it develops simultaneously with the opening of the auditory meatus. However, it does not seem to be dependent on vision, as stated by HANZAK (1966). According to VLASAK (1972) caravan forming in the young shrews is most probably connected with smell and later by touch, audition and vision.

Weaning in *C. russula monacha* occurs between the second and the third week of life, as in *Suncus murinus* (DRYDEN 1968), *Suncus etruscus* (VOGEL 1970), *Crocidura bicolor* (ANSELL 1969) and *C. suaveolens* (HANZAK 1966; VLASAK 1972), and conforms with the weaning period in some of the Soricinae, *Sorex araneus* and *Cryptotis parva*. It can be concluded that, in the whole subfamily Crocidurinae, the postnatal development is fairly identical in its main character.

Postnatal development in *C. russula monacha* is also comparable to growth and development in some representatives of the Tupaiidae, considered as advanced Insectivora. Both *T. belangeri* and *C. russula* grow extremely rapidly during the nestphase and the protein content of the milk is high (10.4% resp. 10.0%). According to MARTIN (1968), a rapid growth rate is typical of nidicolous mammals with primitive mammalian characters, in contrast to the nidifugous type of mammals presenting rather a slow growth rate.

PORTMANN (1965) has shown that the nidifugous form in mammals is to be derived from a primitive nidicolous stage of embryonic development. Accepting this general conclusion, and since most of the Insectivora (including Soricidae)

Table 3

Age — when the eyes open, in 2 groups of insectivores

authors	Tenrecidae	Crocicurinae	authors
GOULD and EISENBERG (1966)	<i>Hemicentetes</i> 8—10 days <i>Echinops</i> 7— 9 days <i>Setifer</i> 13 days	1. <i>Suncus murinus</i> 7—10 days 2. <i>Crocicidura russula monacha</i> 7—10 days 3. <i>C. suaveolens</i> 7— 9 days 4. <i>C. suaveolens</i> 9—10 days 5. <i>C. leucodon</i> 12—14 days	DRYDEN (1968) HELLWING VLASAK (1972) HANZAK (1966) FRANK (1954)

present the nidicolous type of offspring, one can speculate about the origin of recent Placentalia. They appear to derive from nidicolous ancestors with a postnatal development similar to that found also in the recent shrews.

### Summary

Data on the postnatal development were obtained from 745 litters of *Crocicidura russula monacha* born in captivity.

*C. russula monacha* are born as nidicolous young and grow very rapidly in the nest. The average body weight on the day of birth is 0.8 g. The time required for doubling the initial body weight is 3 days. The most rapid weight gain is observed from birth until day 12. By weaning (22 to 24 days) the body weight has increased 9 fold and the body length 2.2 fold. The rapid postnatal growth is correlated probably with a high protein content of the milk (10%). Eyes open at about 10 days and teeth have entirely erupted by day 15. A characteristic behaviour, the caravanning begins at the age of 6 days and lasts until weaning. Suckling was observed until days 22 to 24, but the young start to feed partially on solid food after the second week of life.

### Zusammenfassung

#### *Die postnatale Entwicklung der Spitzmaus Crocicidura russula monacha in Gefangenschaft*

Die Jugendentwicklung von *Crocicidura russula monacha* unter Gefangenschaftsbedingungen wurde an Hand von 745 Würfeln eingehend studiert. *C. russula monacha* wird als typischer Nesthocker geboren. Die Entwicklung im Nest vollzieht sich sehr schnell. Das durchschnittliche Körpergewicht am Tage der Geburt ist 0,8 Gramm. Um das ursprüngliche Geburtsgewicht zu verdoppeln, benötigt diese Spitzmaus nur drei Tage. Die schnellste Gewichtszunahme wird vom Tage der Geburt bis zum zwölften Lebenstag beobachtet. Am Ende der Entwöhnungsperiode (22. bis 24. Tag) ist das Körpergewicht um das Neunfache gestiegen. Die Körperlänge hat sich während dieser Zeitspanne mehr als verdoppelt ( $\times 2,2$ ). Die schnelle postnatale Entwicklung ist anscheinend durch den hohen Proteingehalt der Milch (10%) bedingt. Die Augen sind am 10. Tag völlig offen, und das Gebiß ist am 15. Tag vollkommen entwickelt.

Die Karawanenbildung beginnt im Alter von sechs Tagen und dauert bis zum Ende der Entwöhnungsperiode an. Die Jungtiere saugen bis zum Alter von 22 bis 24 Tagen, beginnen aber bereits, in der zweiten Lebenswoche sich teilweise selbständig zu ernähren.

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